Tendenze dello stato trofico e delle ipossie nel golfo di Trieste

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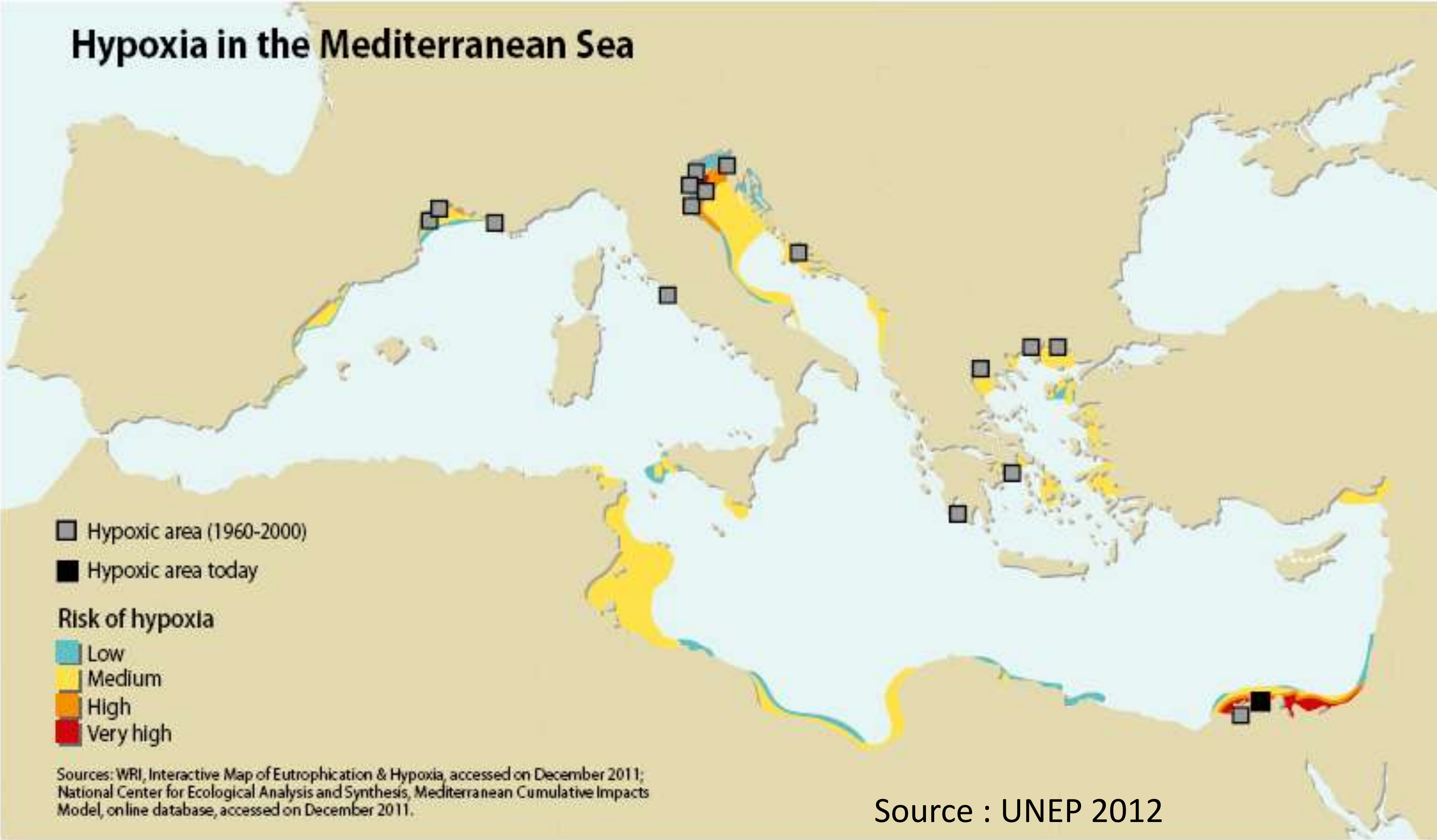
Cesenatico 15 marzo 2019

OGS

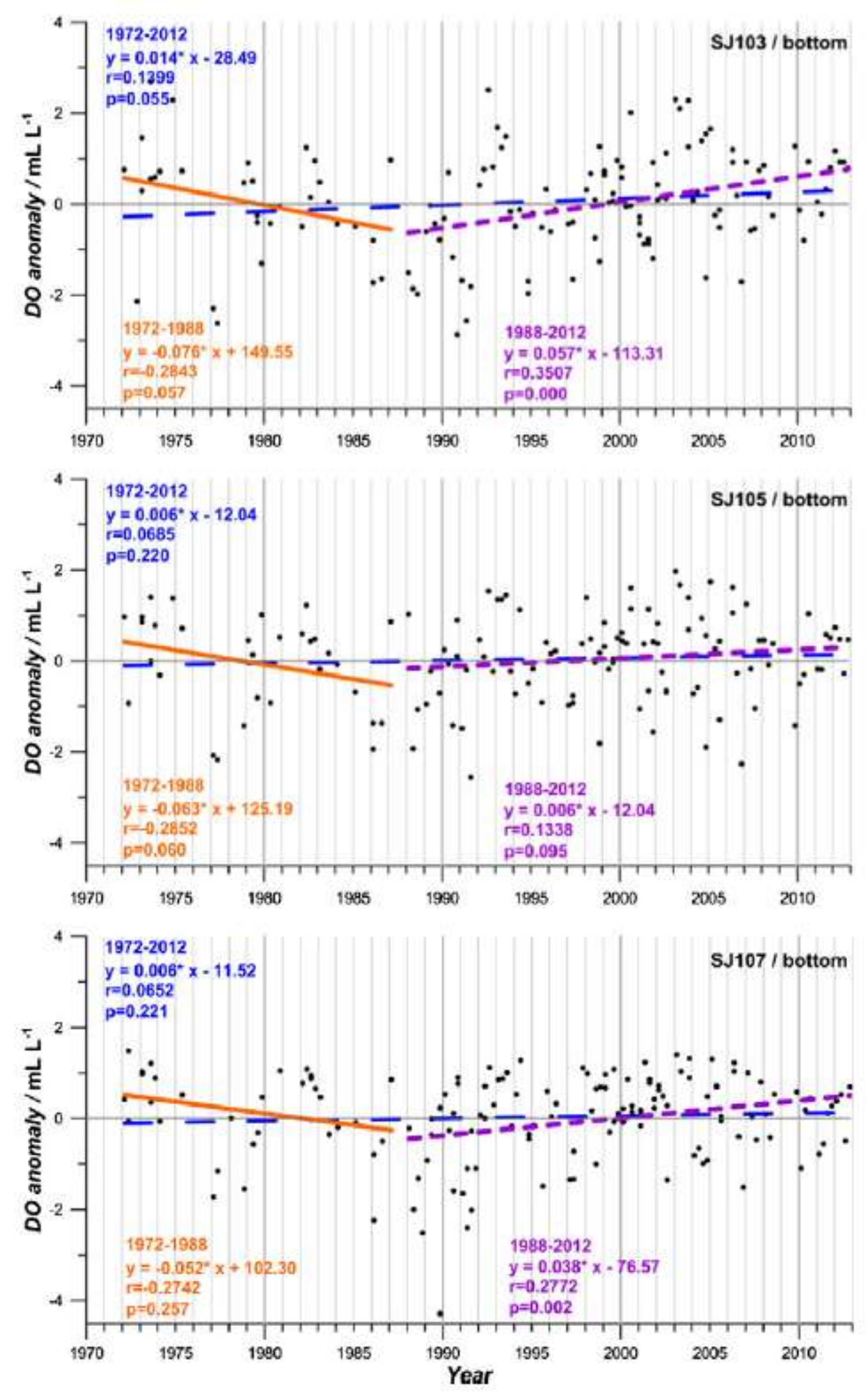
NIB
NATIONAL INSTITUTE OF BIOLOGY

arpa FVG
agenzia regionale per la protezione dell'ambiente del Friuli Venezia Giulia

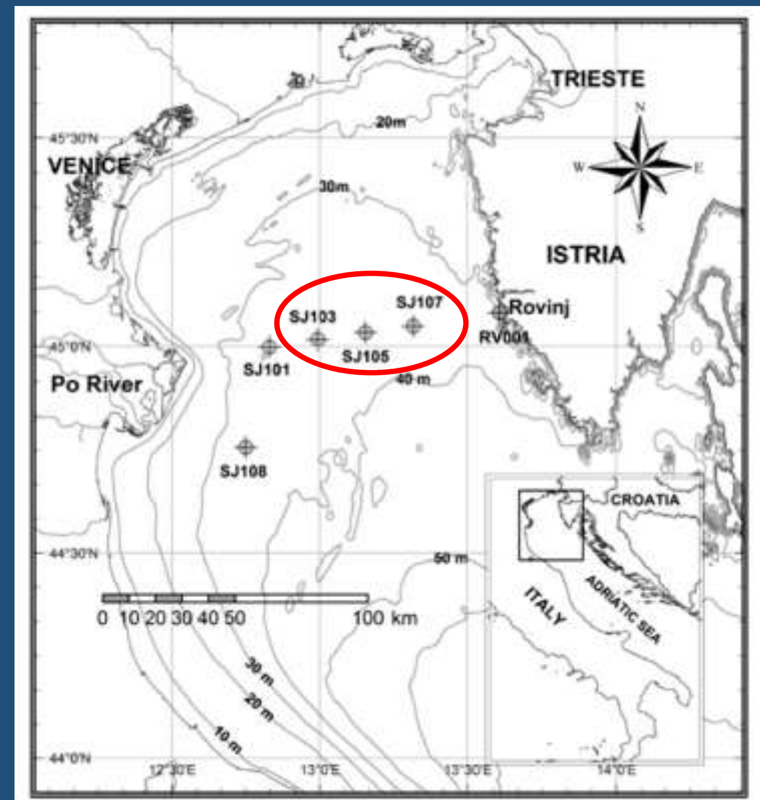
Hypoxic zones in Mediterranean Sea



Source : UNEP 2012



Oxygen in bottom waters 1972-2012



From

Djakovac T, Supic N, Bernardi Aubry F, Degobbis D, **Giani M**

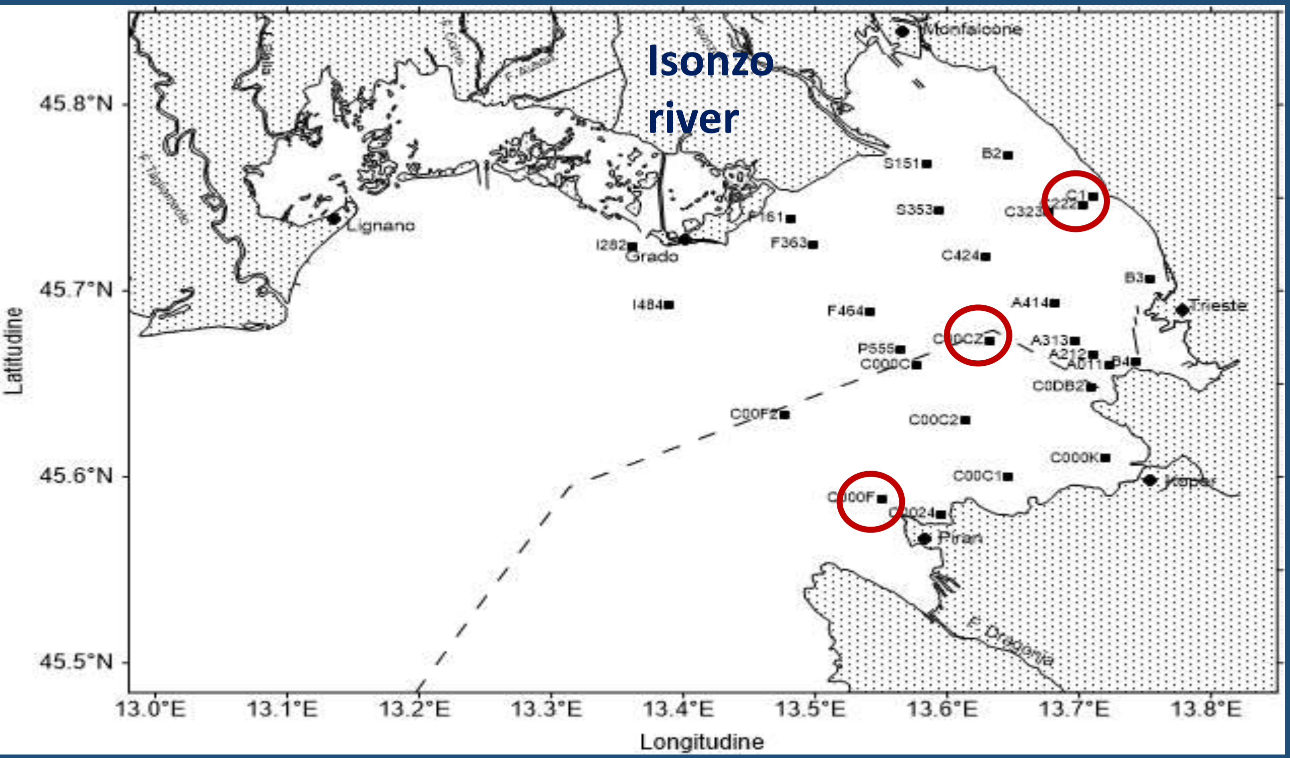
Mechanisms of hypoxia frequency changes in the northern Adriatic Sea during the period 1972-2012

Jour. Mar. Systems 141: 179-189, 2015

Objectives

- evaluate the temporal and spatial extent of some recent hypoxia events
- verify if there are long term changes of the nutrients, chlorophyll a, andoxygen concentrations in the waters
- identify the main drivers of the O_2 changes and of the recent hypoxic events

Gulf of Trieste



Bottom depths

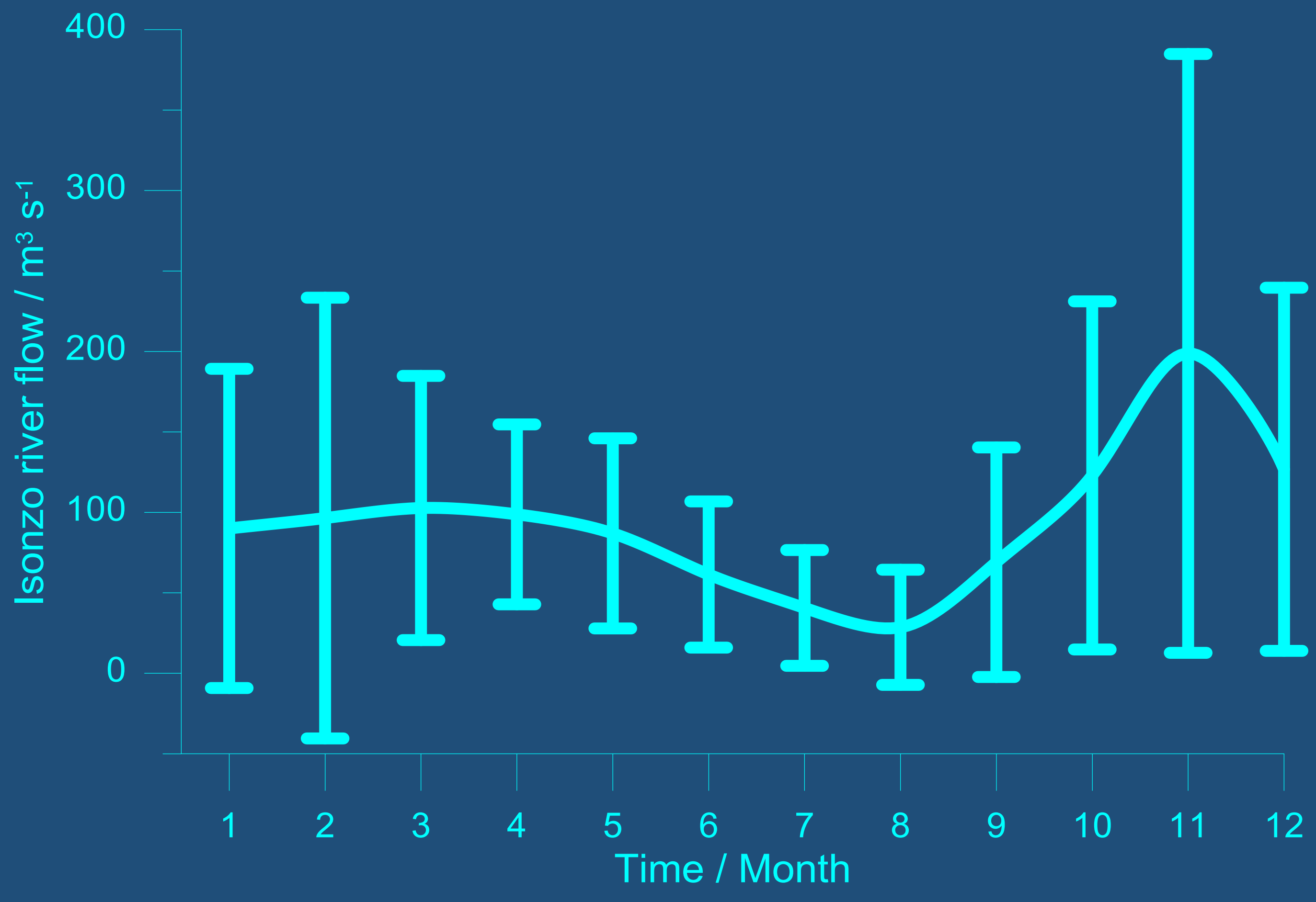
C1: 17.5 m

CZ: 24 m

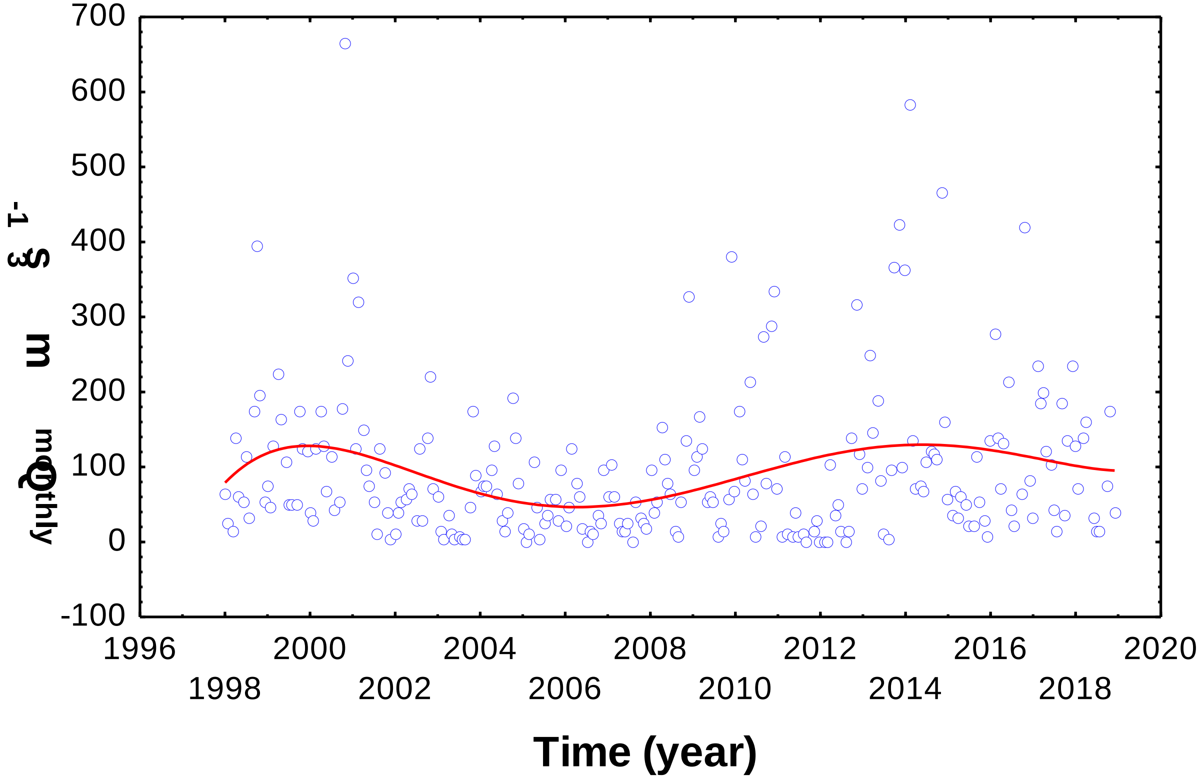
00F: 22 m

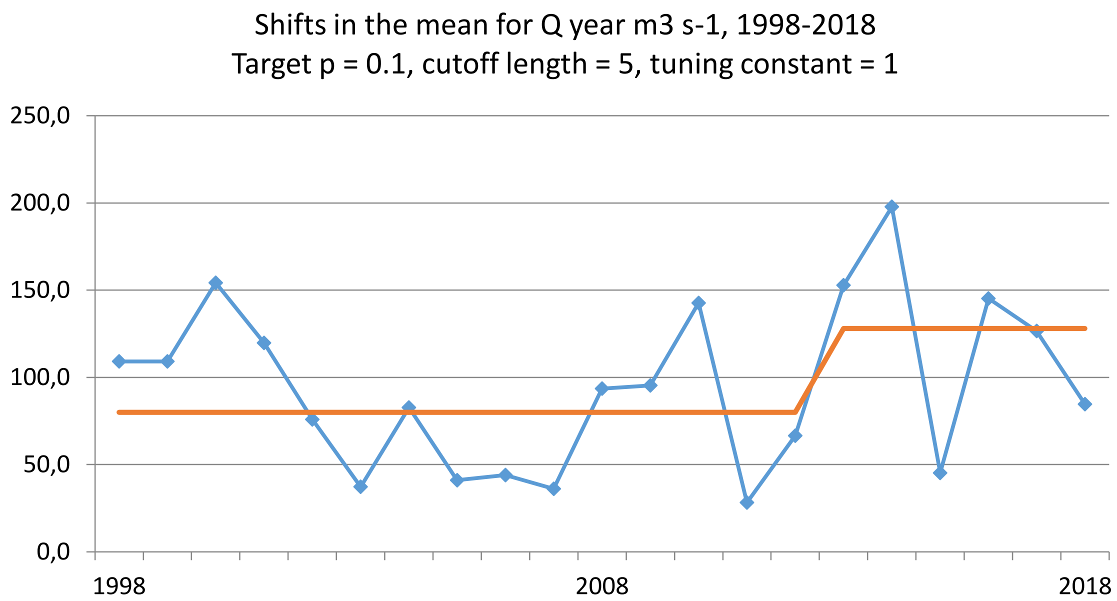
- CDT O2 profiles at 28 stations in July & August 2015&16; ARPAFVG, OGS, NIB
- C1 1986-2016, monthly T, S, O2, chla, nutrients; OGS
- 00F 1983-2016, monthly T, S, O2, chla, nutrients; NIB
- CZ 1989-2016, monthly T, S, O2, chla, nutrients; NIB
- Plankton respiration, Primary production measures, OGS & NIB

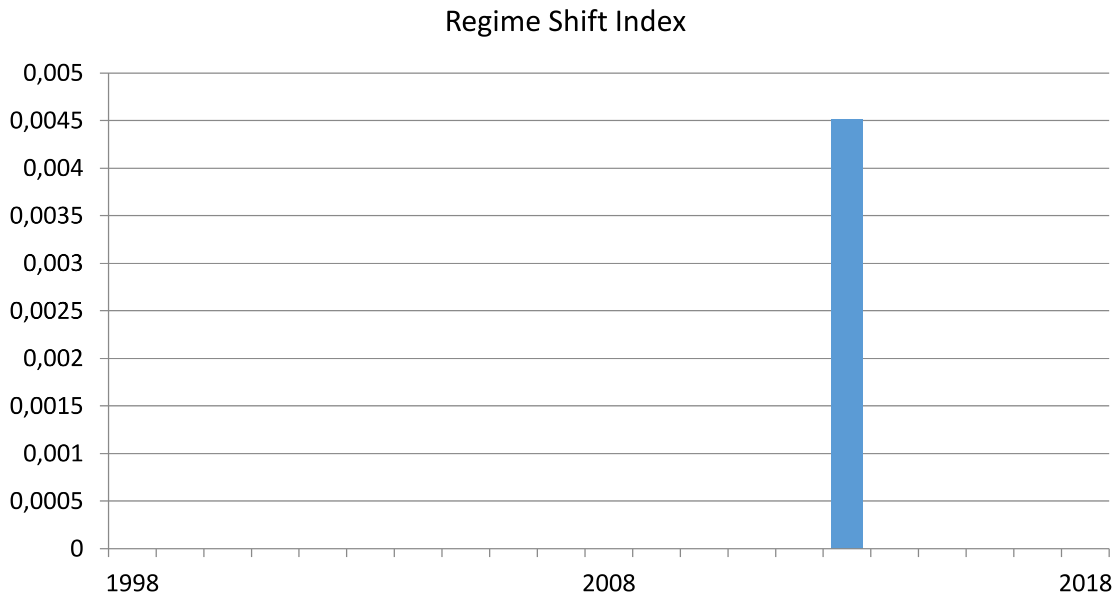
Monthly flow of Isonzo river 1998-2016

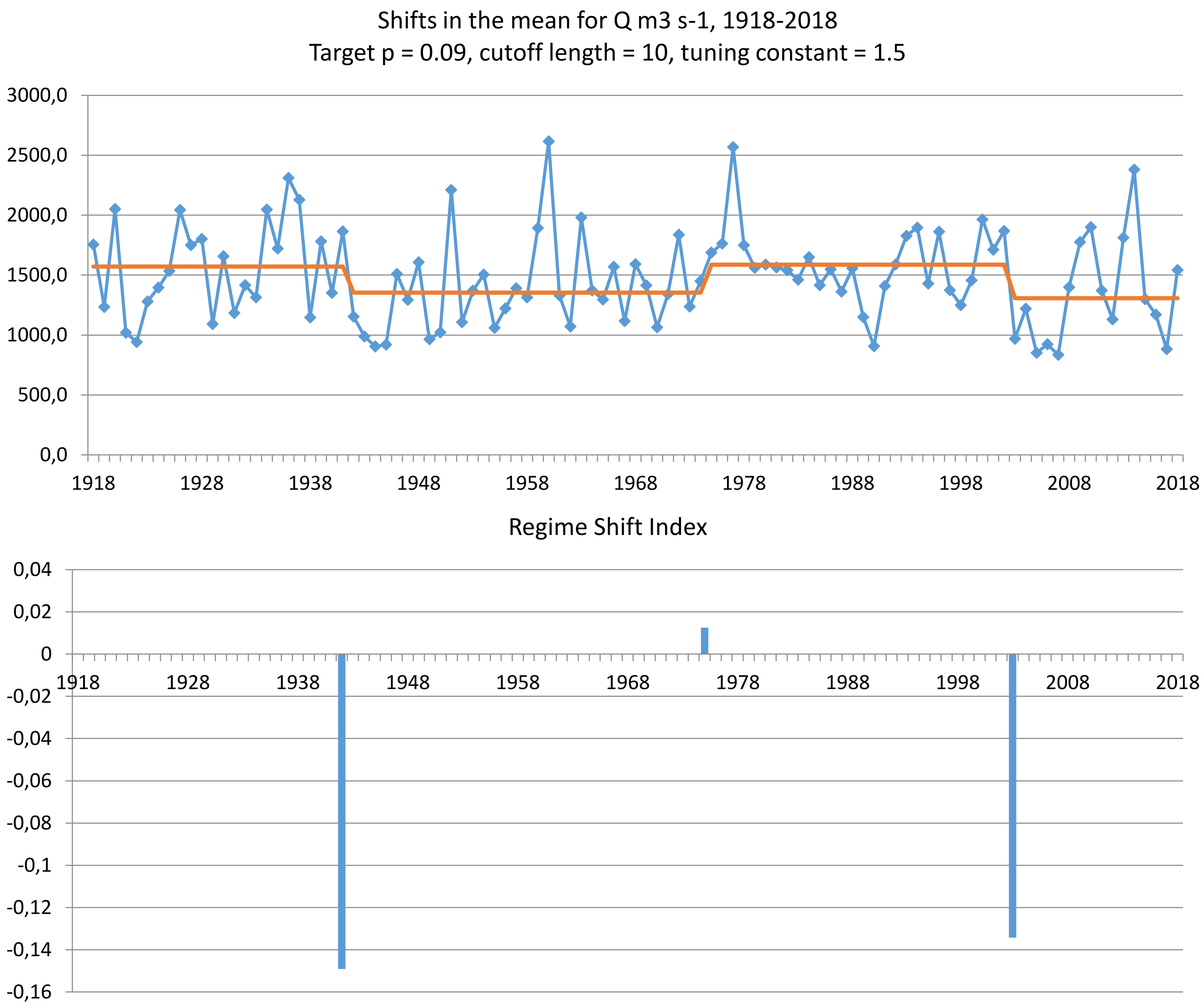


Isonzo River discharge
1998-2018



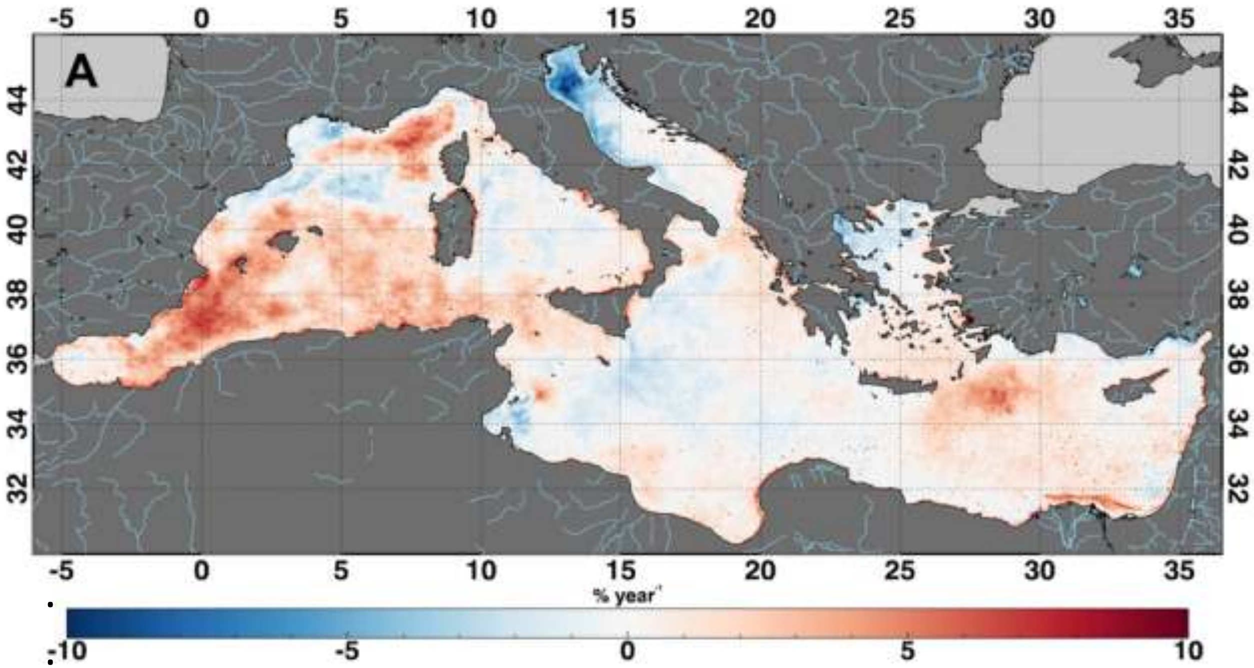

Shifts in the mean for Q year m3 s-1, 1998-2018
Target p = 0.1, cutoff length = 5, tuning constant = 1
250,0
200,0
150,0
100,0
50,0
0,0
1998
2008
2018


Regime Shift Index
0,005
0,0045
0,004
0,0035
0,003
0,0025
0,002
0,0015
0,001
0,0005
0
1998
2008
2018

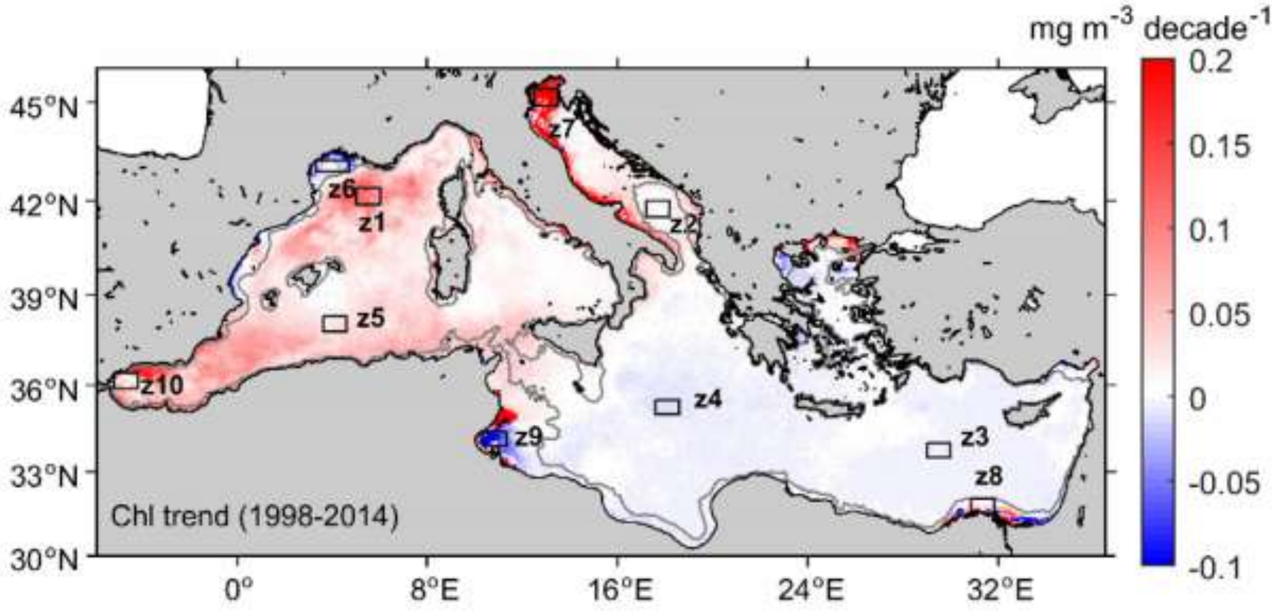


1942 1975 2003

Chlorophyll concentration trend relative to 1998–2009 time period. From Colella et al., 2016



Chl trends in the Mediterranean Sea for the 1998–2014.

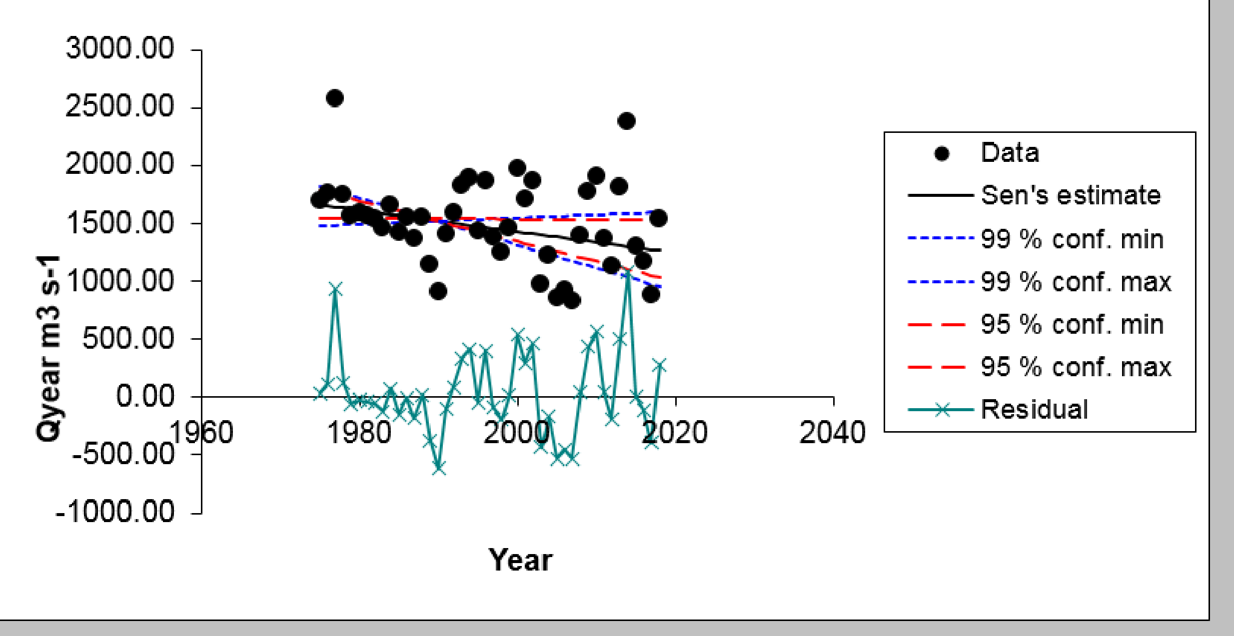


From Salgado-Hernanz et al., 2019

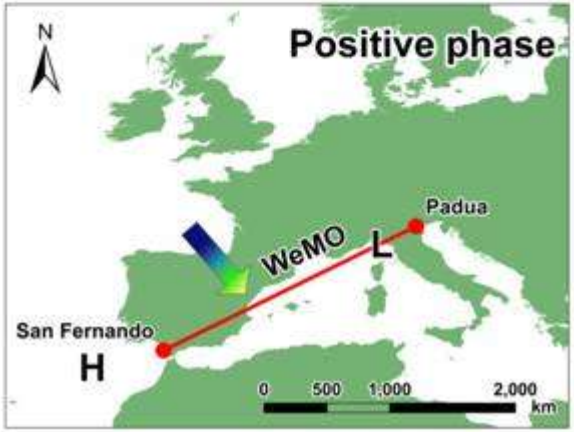
Remote Sensing of Environment 221 (2019) 50–64

Po river discharges
Man Kendall test
Period: 1975-2018 (44 years)

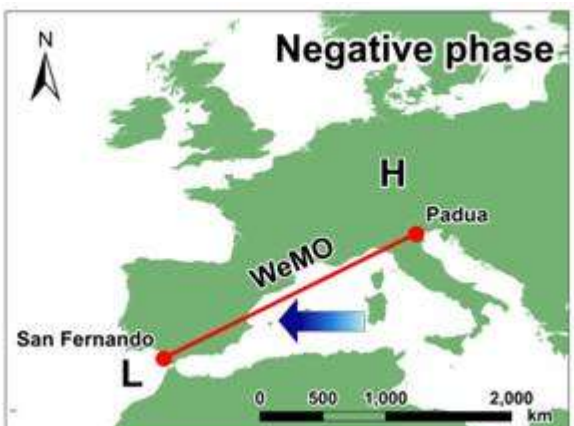
TsNumber	2
Name	Qyear m3 s-1
Years	1975 - 2018
N	44
Test S	
Test Z	-2.01
signific.	*
Q	-9.18E+00
Qmin99	-2.01E+01
Qmax99	2.66E+00
Qmin95	-1.74E+01
Qmax95	-5.24E-01
B	2.18E+03
Bmin99	2.96E+03
Bmax99	1.33E+03
Bmin95	2.77E+03
Bmax95	1.58E+03



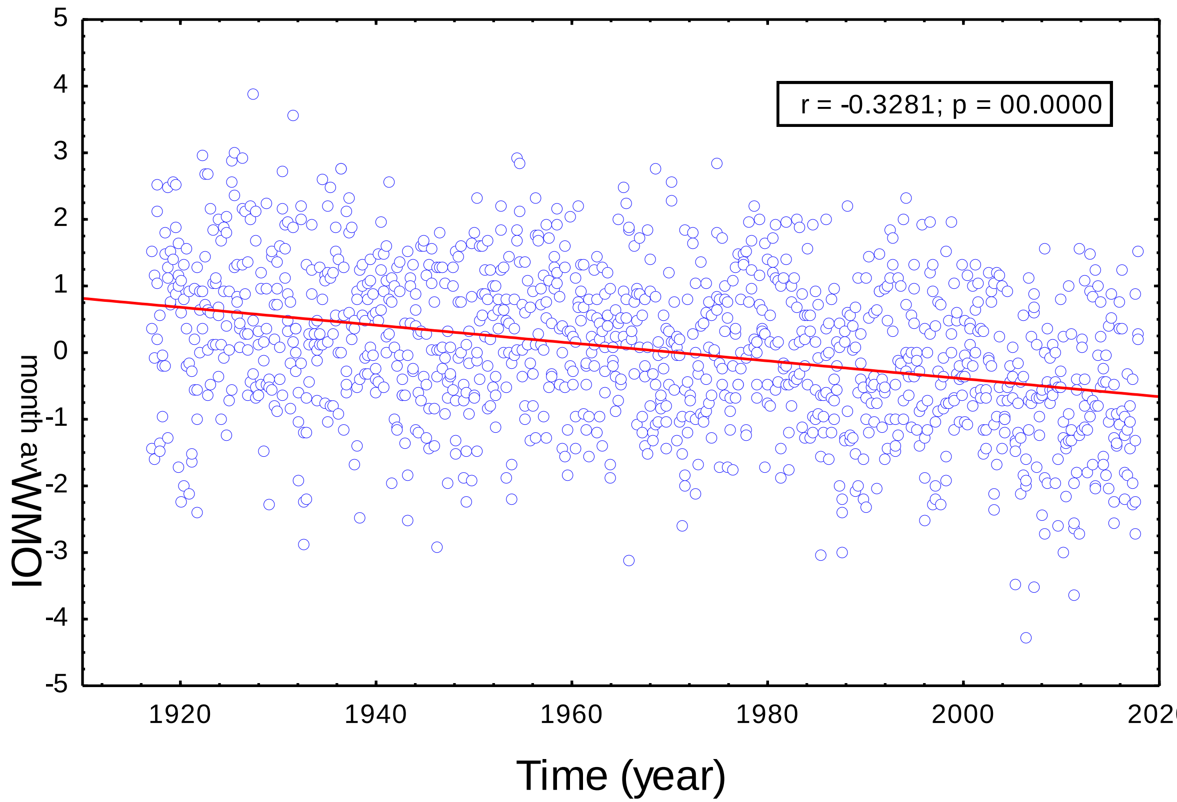
WMOI>0



WMOI<0

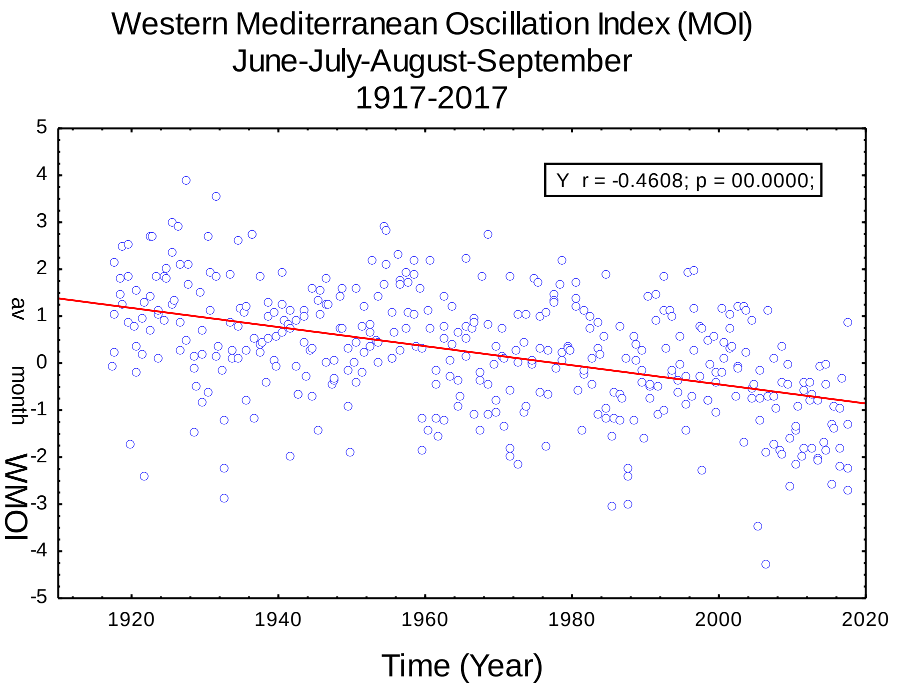


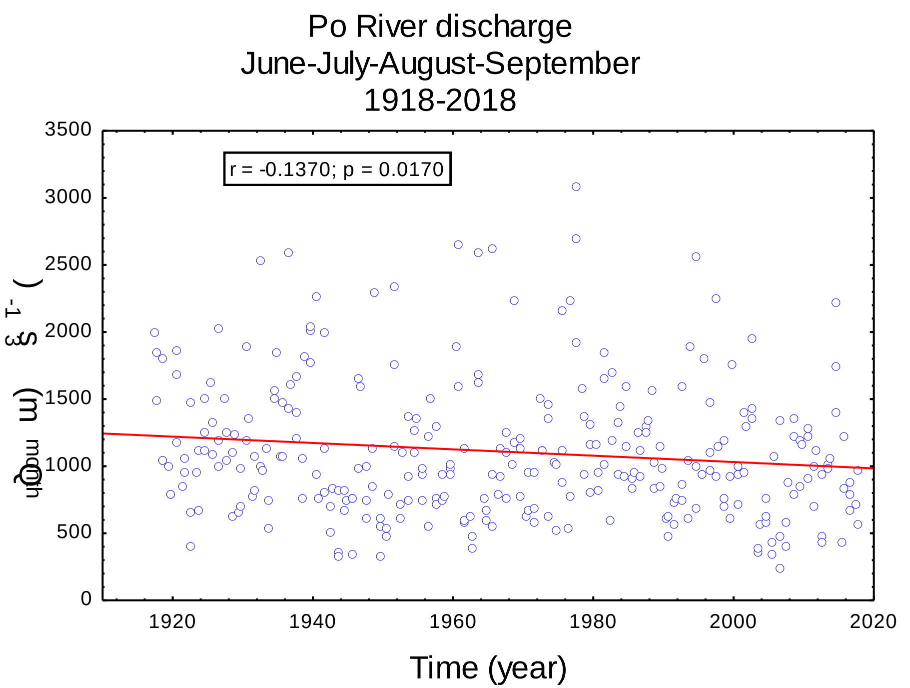
Western Mediteranean Oscillation Index (WMOI)
(Cadiz-Padua, 1917-2017)



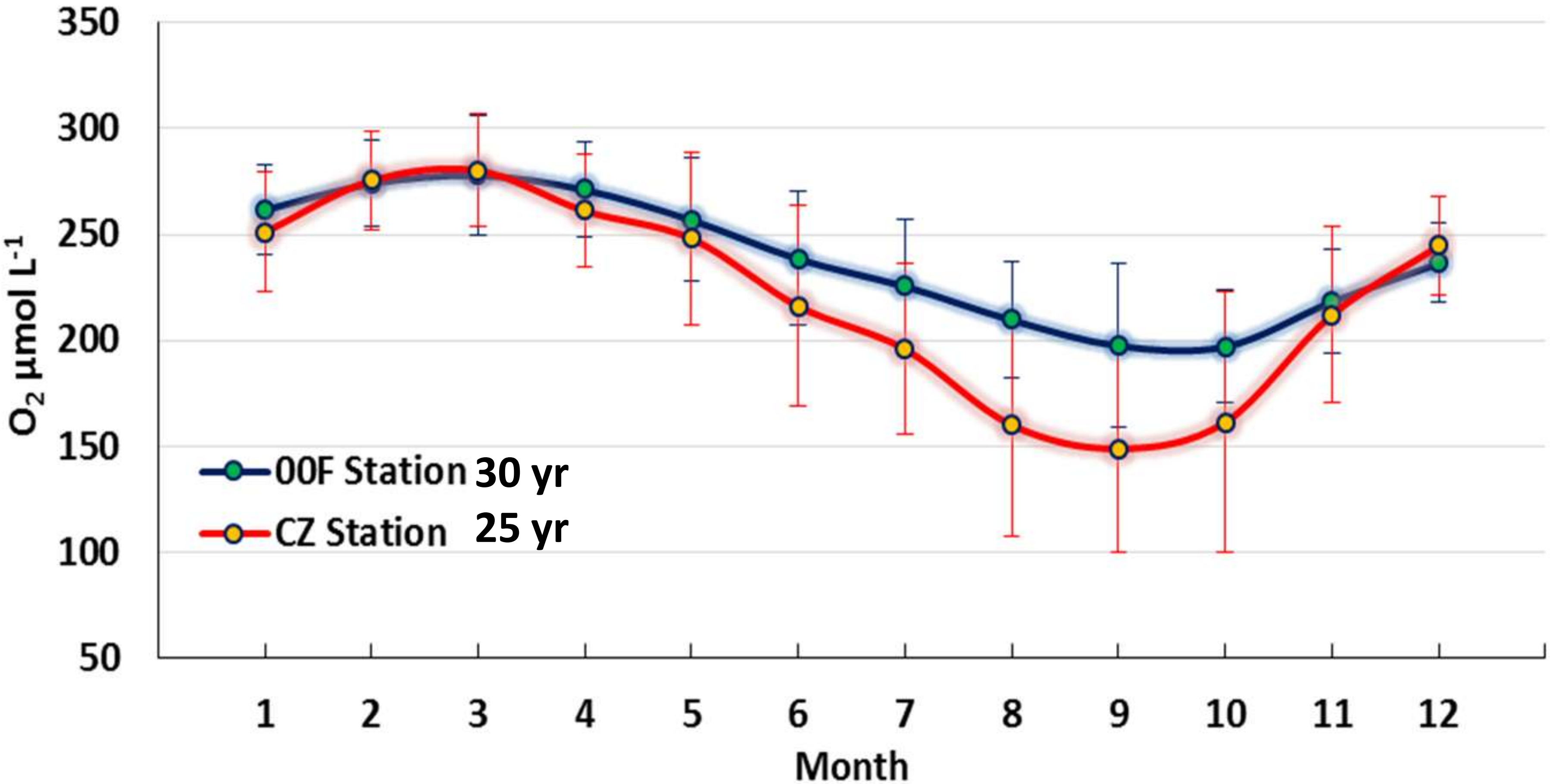
WMOI &Po discharges

Month	Q vs WMOI	1917-2017
	r	p
JAN	0.021	0.833
FEB	0.157	0.118
MAR	0.185	0.065
APR	0.281	0.004
MAY	0.070	0.490
JUN	0.295	0.003
JUL	0.239	0.016
AUG	0.236	0.018
SEP	0.259	0.009
OCT	0.012	0.903
NOV	0.150	0.135
DEC	0.495	0.625





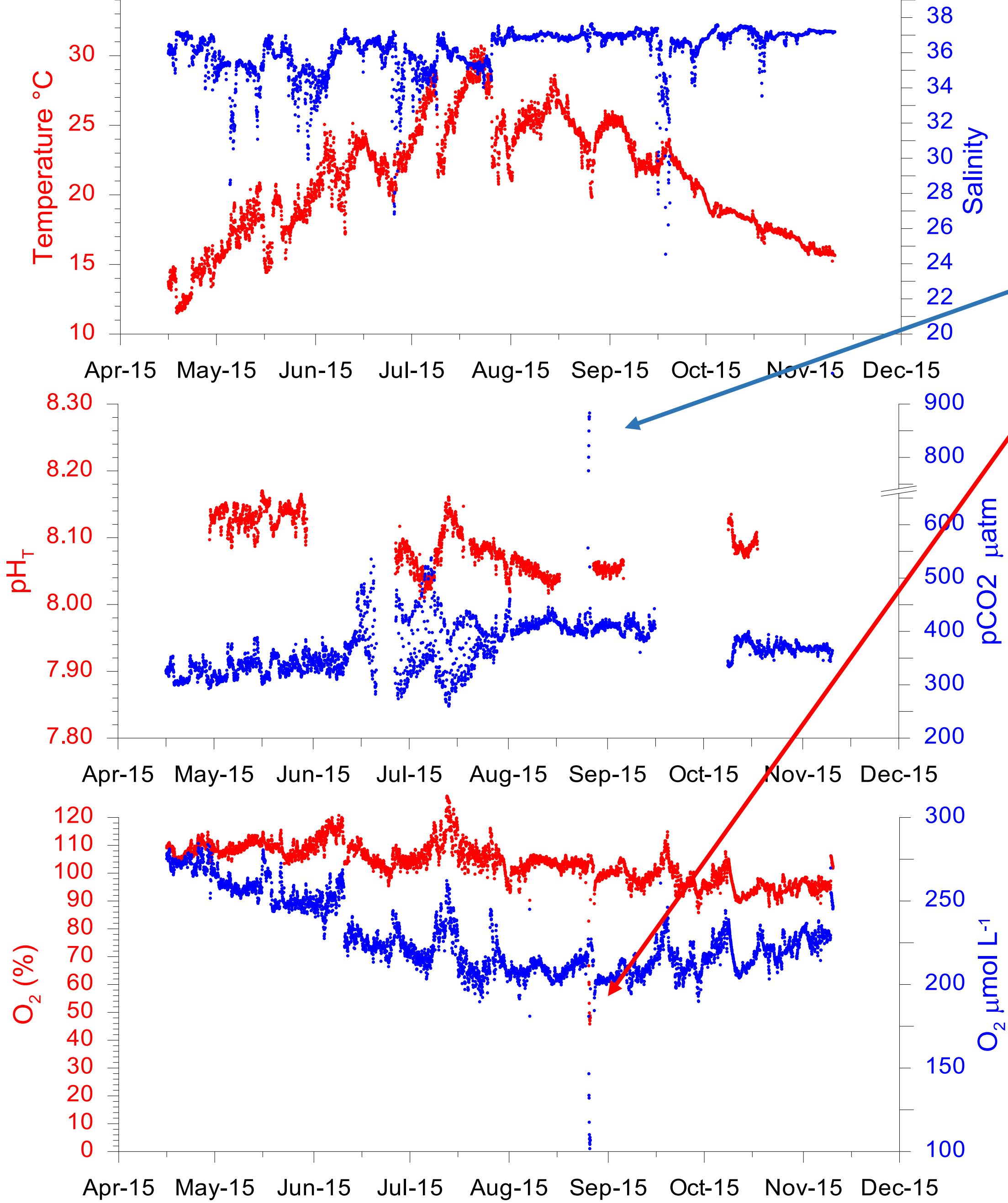
Monthly climatology of dissolved O_2 in bottom waters



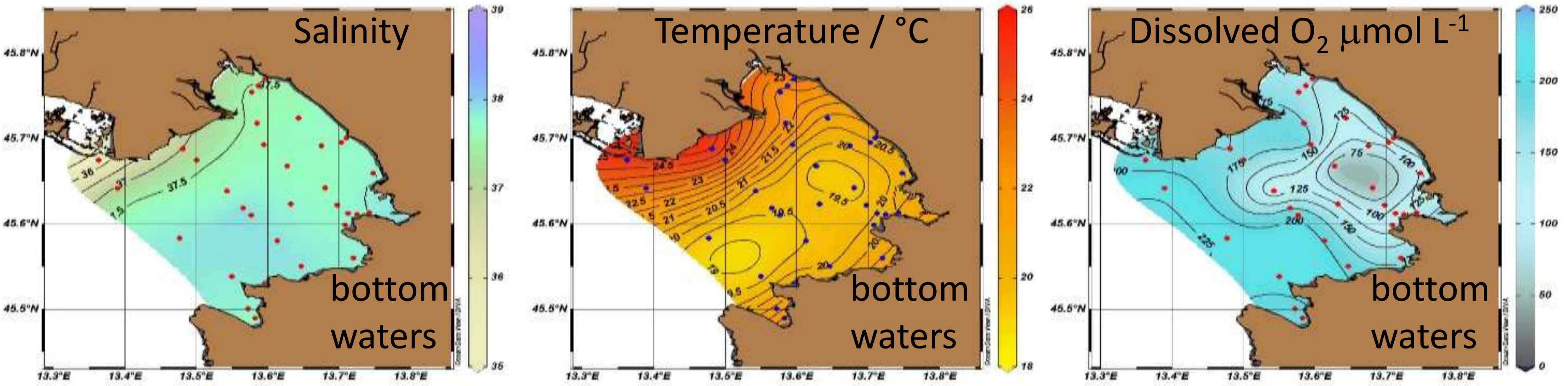
Mambo buoy -1 m

pCO$_2$ increase

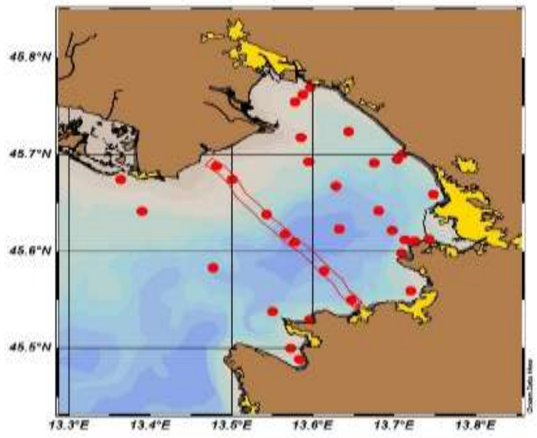
drop of O$_2$

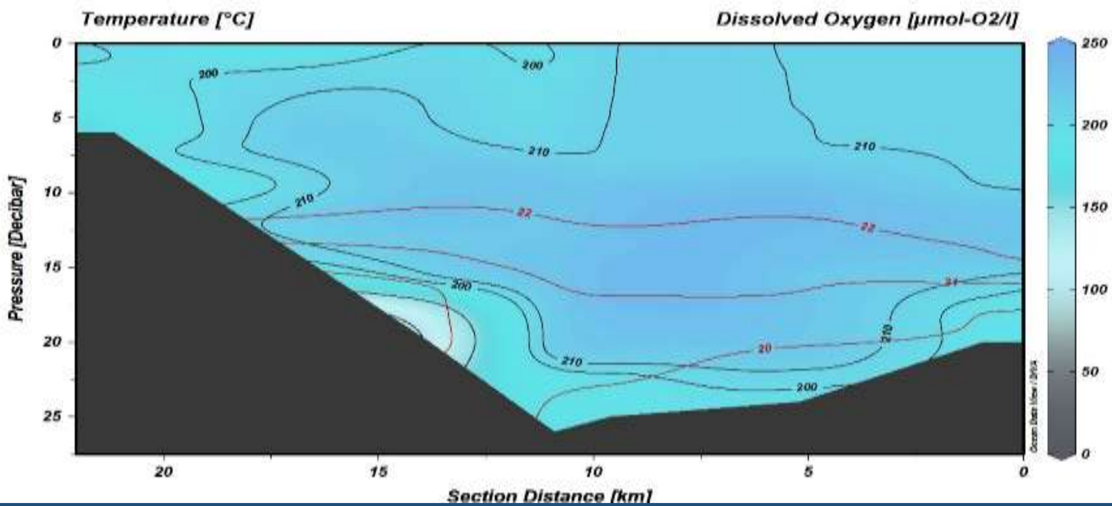


August 2015



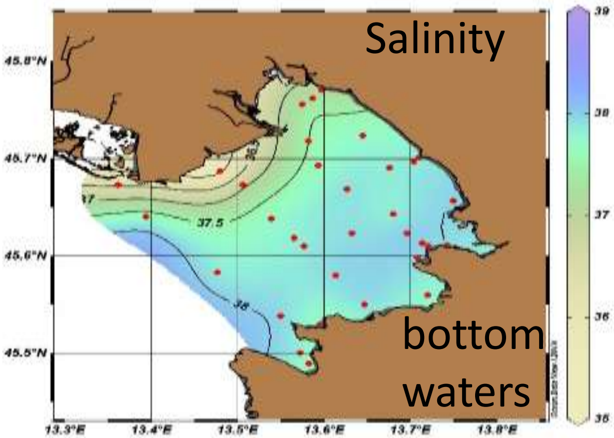
Salinity
bottom waters
Temperature / °C
bottom waters
Dissolved O_2 µmol L^{-1}
bottom waters



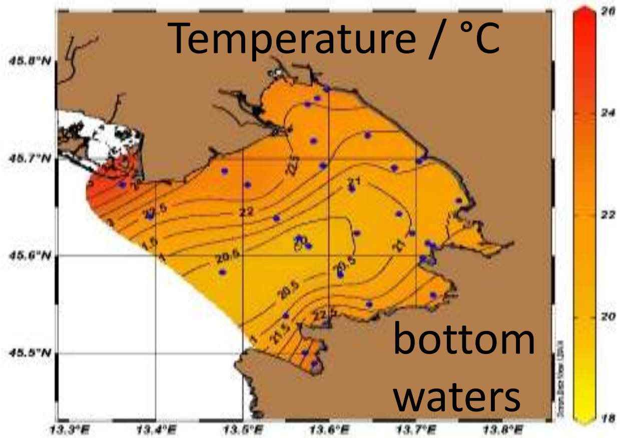


Temperature [°C]
Dissolved Oxygen [µmol-O2/l]
Pressure [Decibar]
Section Distance [km]

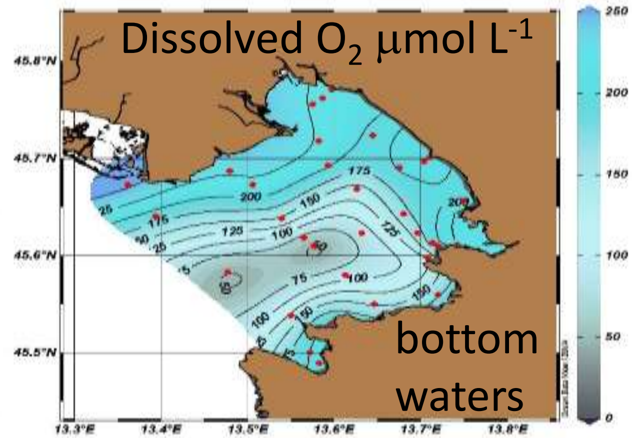
August 2016



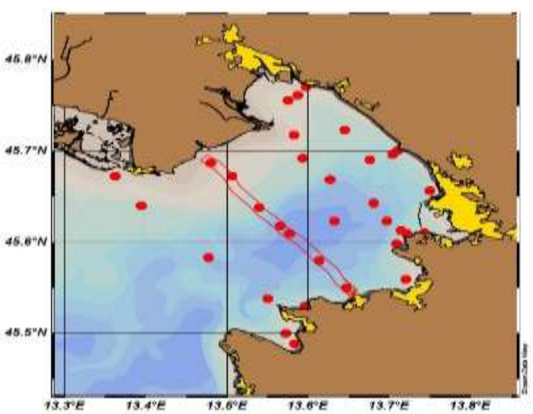
Salinity
bottom waters
45.8°N
45.7°N
45.6°N
45.5°N
13.3°E
13.4°E
13.5°E
13.6°E
13.7°E
13.8°E

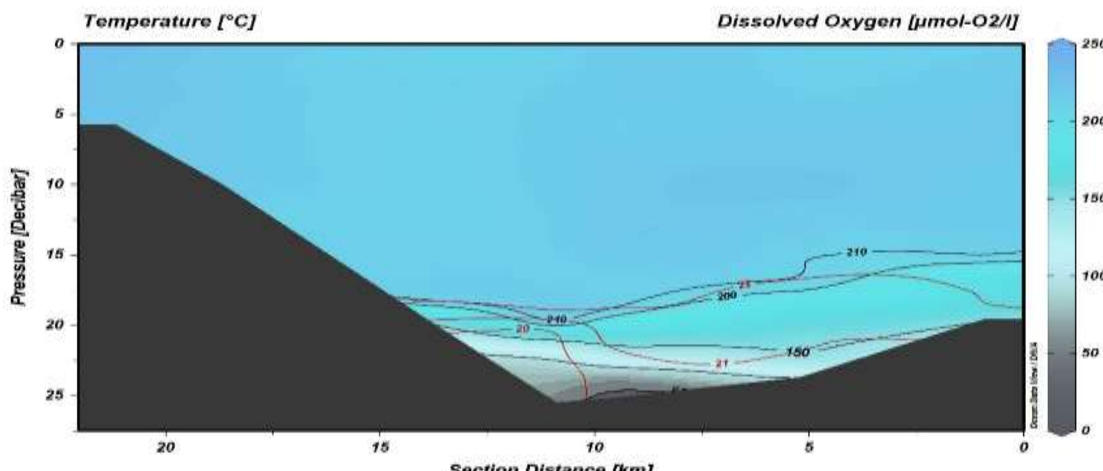


Temperature / °C
bottom waters



Dissolved O_2 µmol L^{-1}
bottom waters

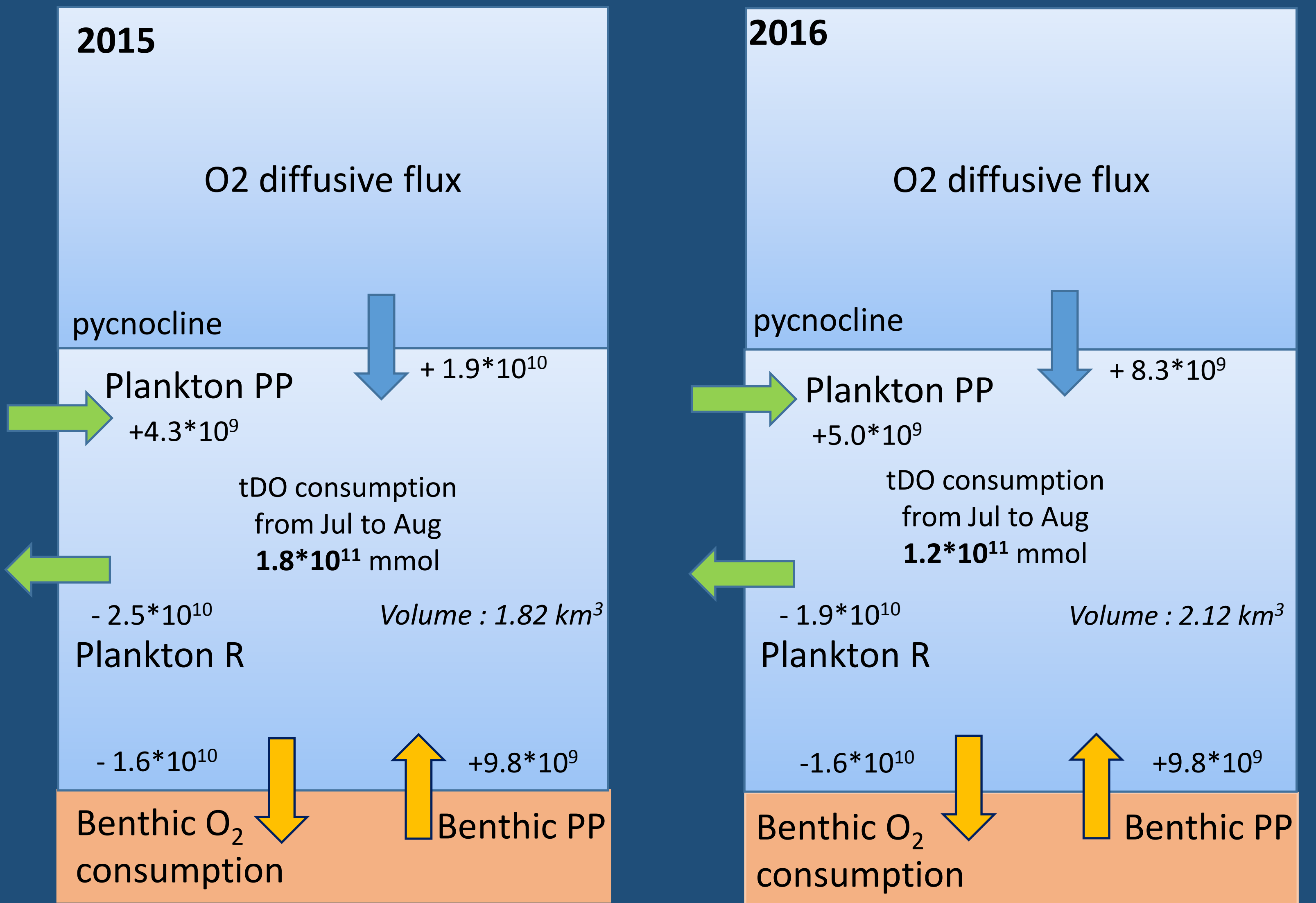




Temperature [°C]
Dissolved Oxygen [µmol-O2/l]
Pressure [Decibar]
Section Distance [km]

Oxygen depletion in bo from July to August

Rates expressed in mmol O_2 d^{-1}



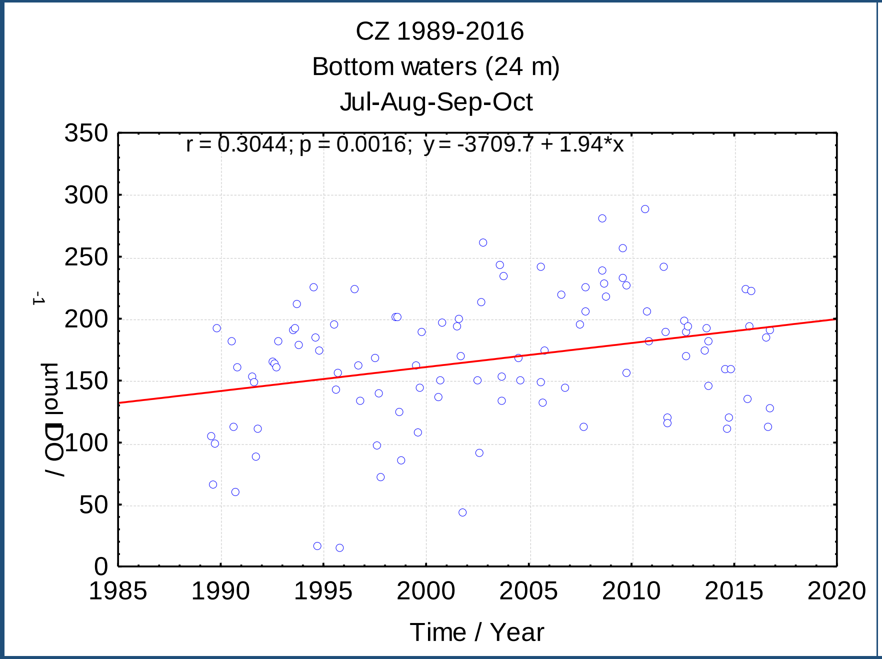
21 days **(44)**

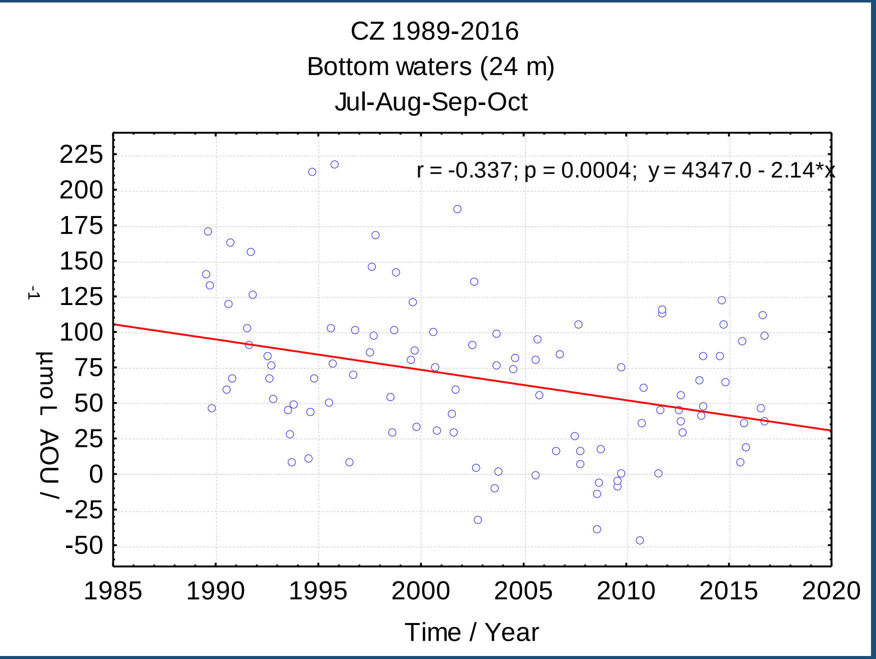
10 days **(27)**

Days needed to deplete the oxygen

(days to reach hypoxia O_2 : 62.5 µmol O_2 L^{-1})

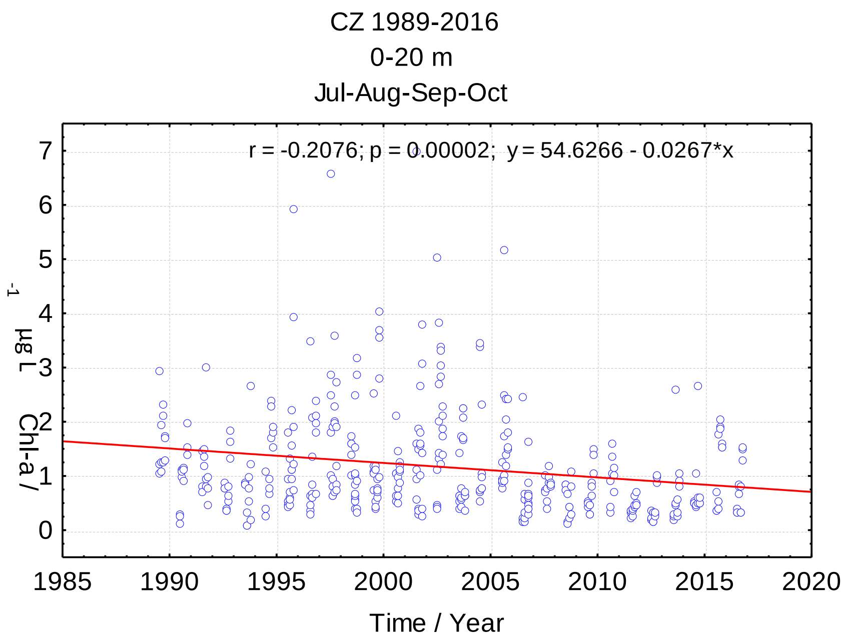
O_2 trend in bottom waters ≥24 m in summer-early autumn

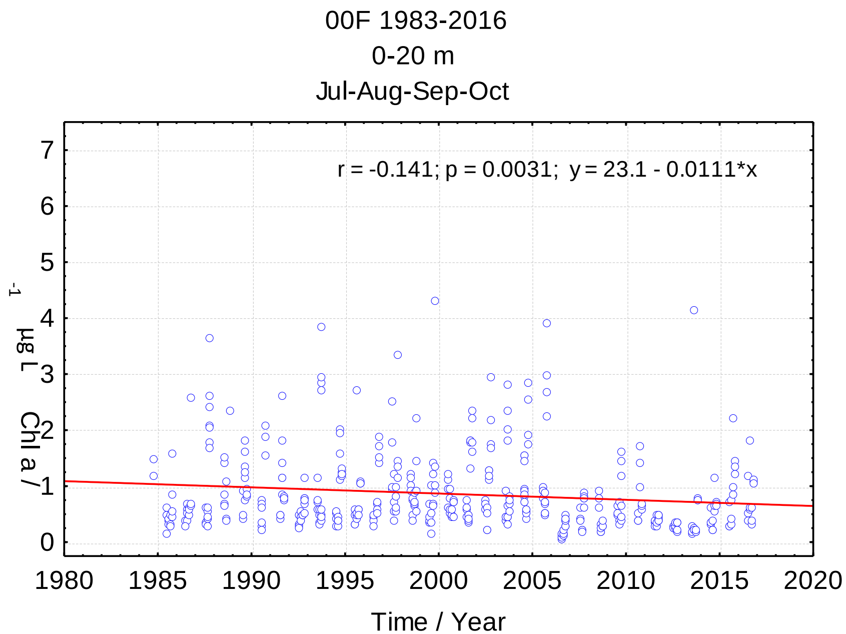


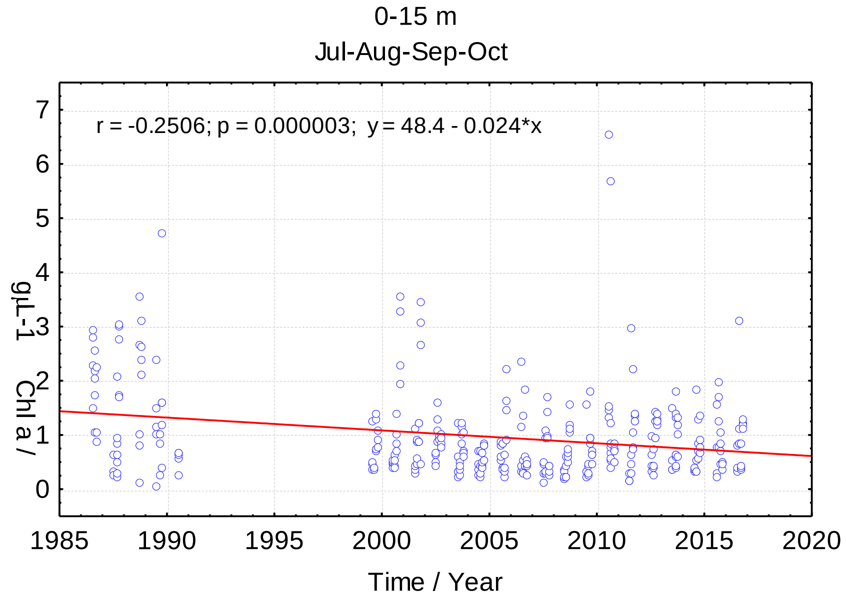


No temperature trends in these waters

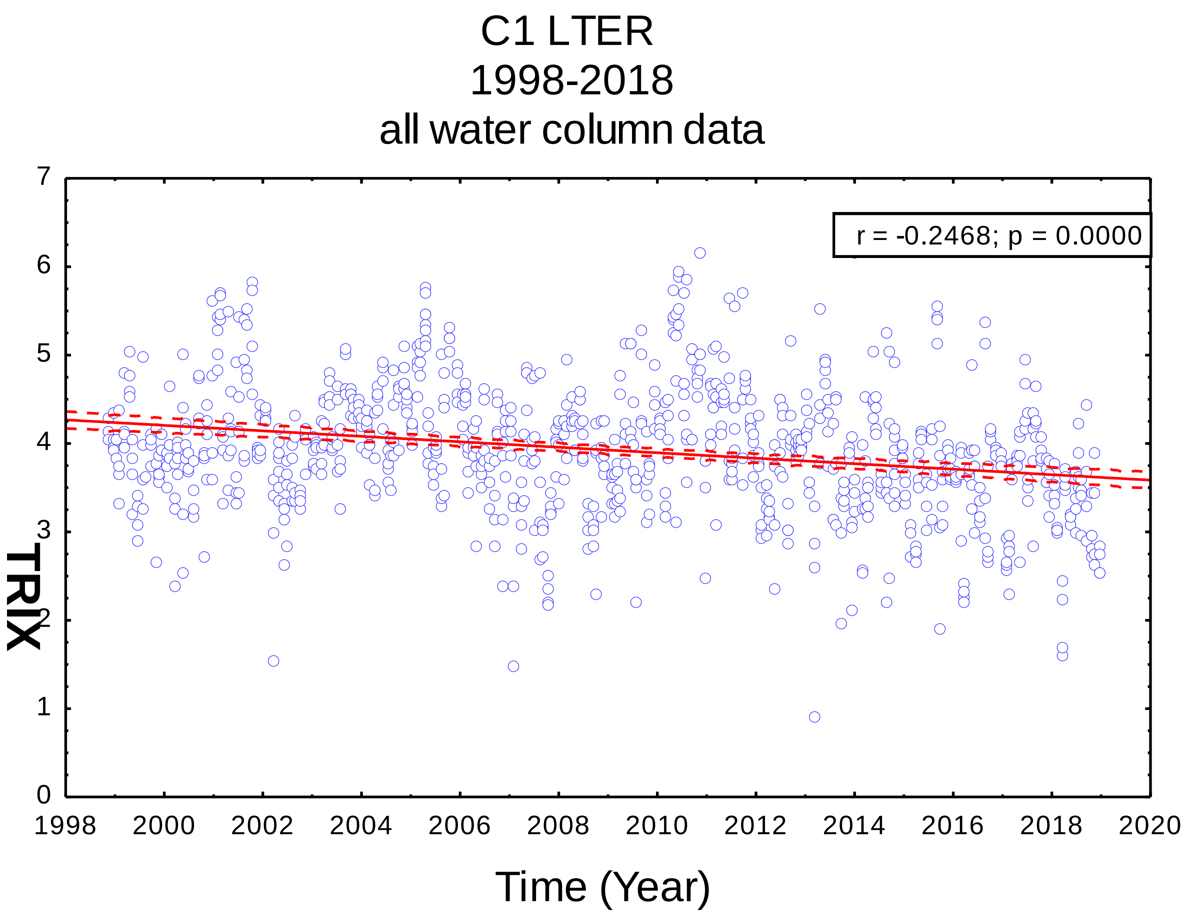
Chlorophyll a trends in water column in summer-early autumn



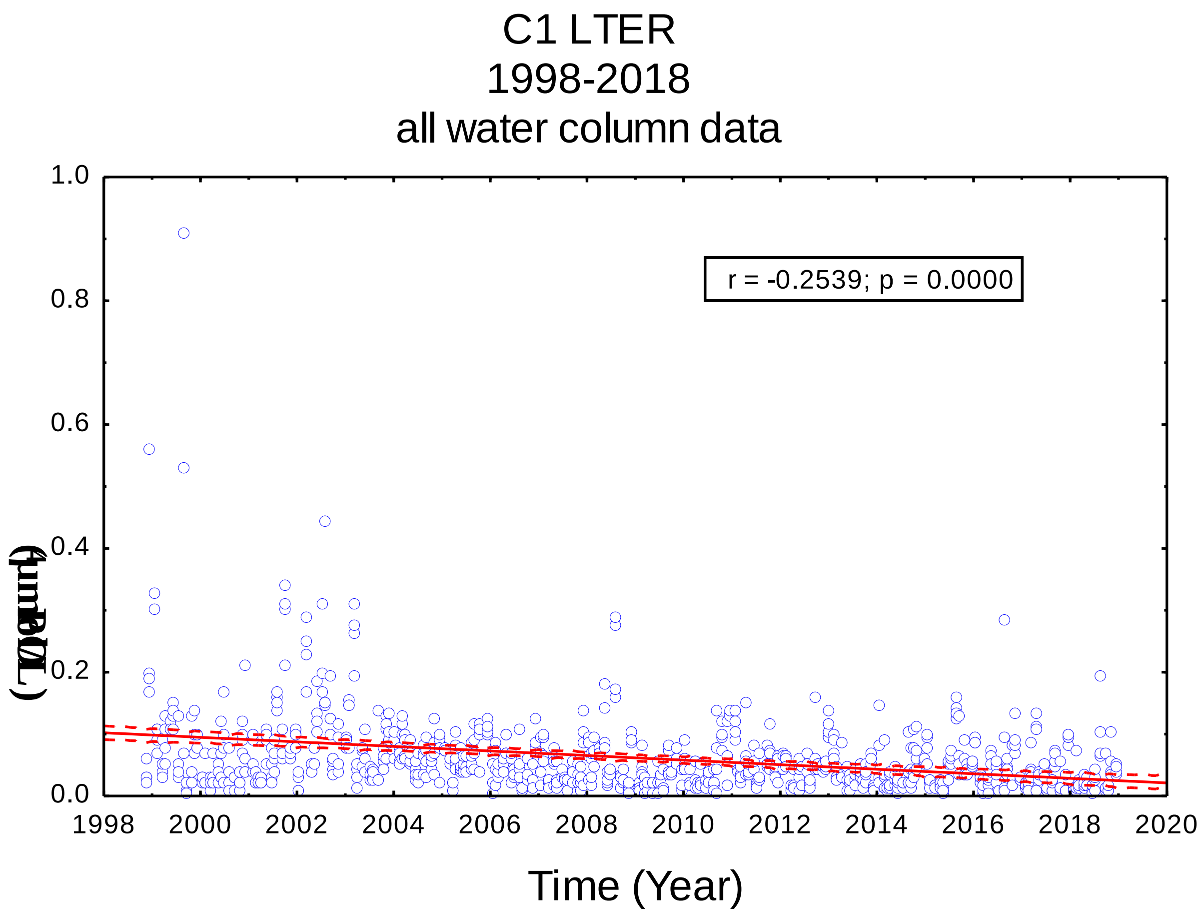




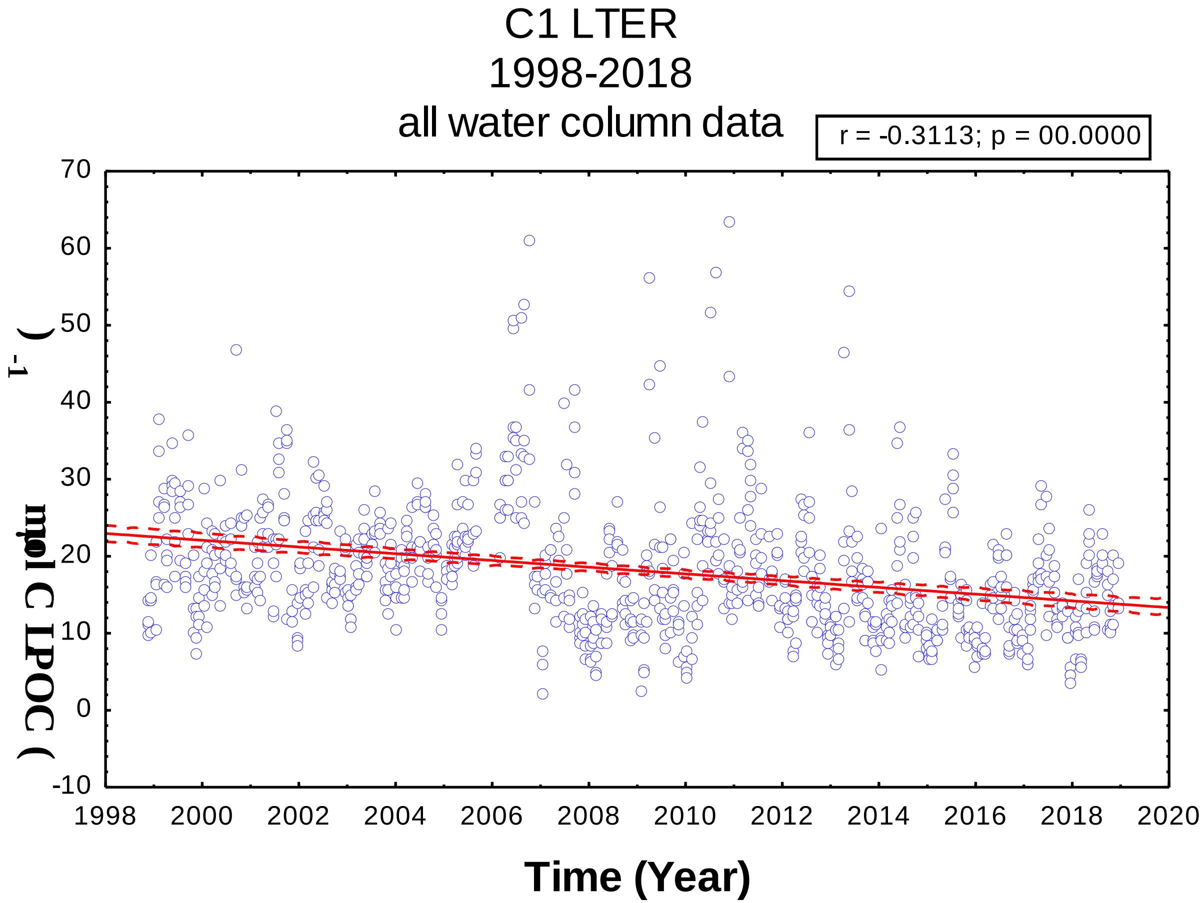
Trend of TRIX index in the water column



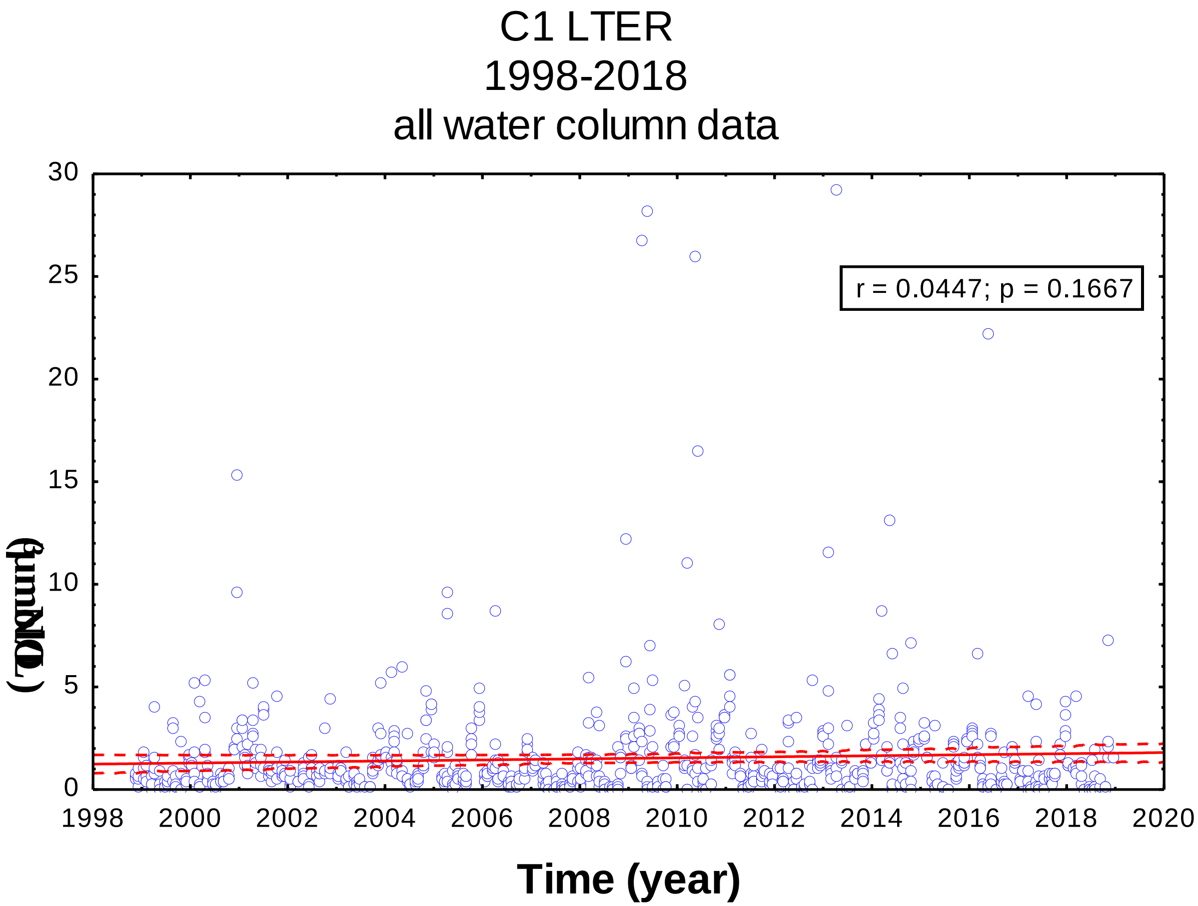
Reactive P trend in the water column in the Trieste gulf



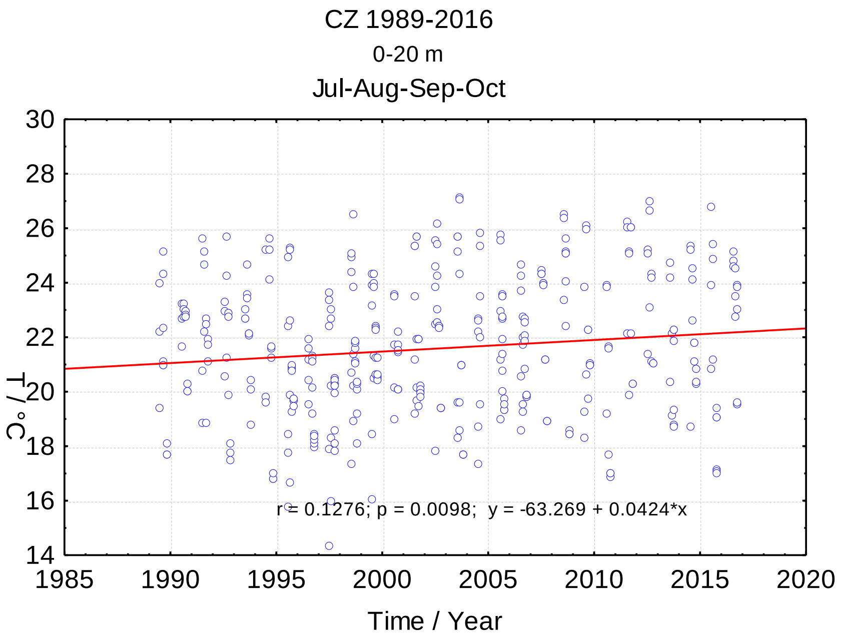
Particulate organic carbon in the Trieste gulf

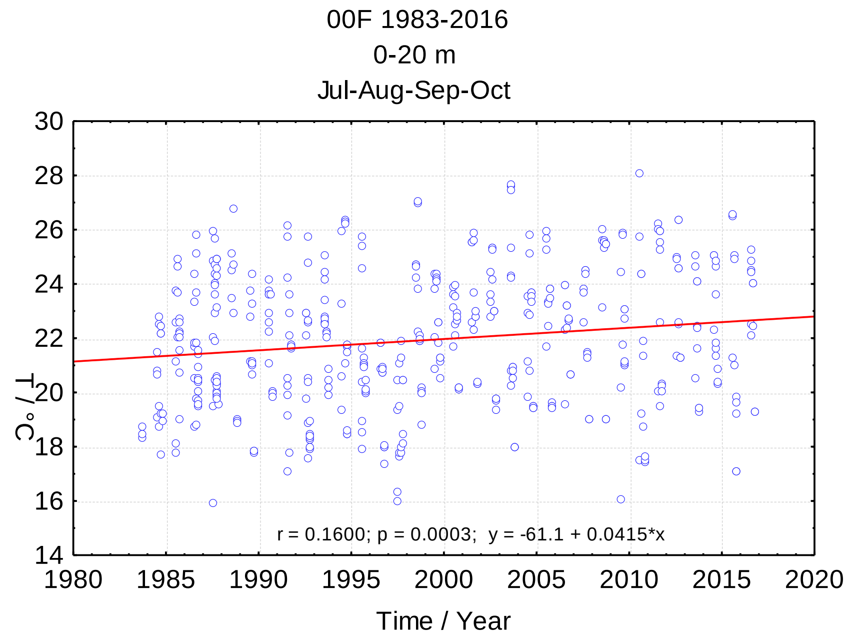


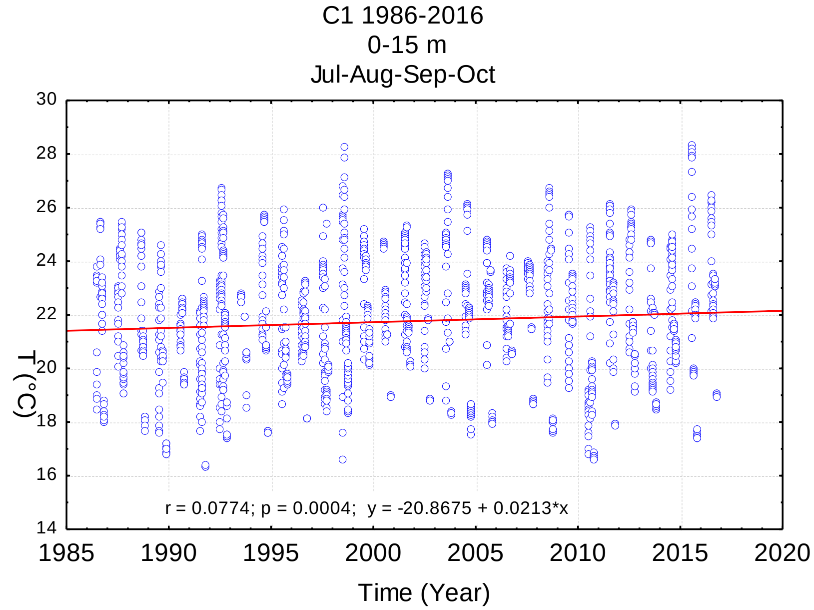
Nitrates trend in the Trieste gulf



Temperature trends in water column



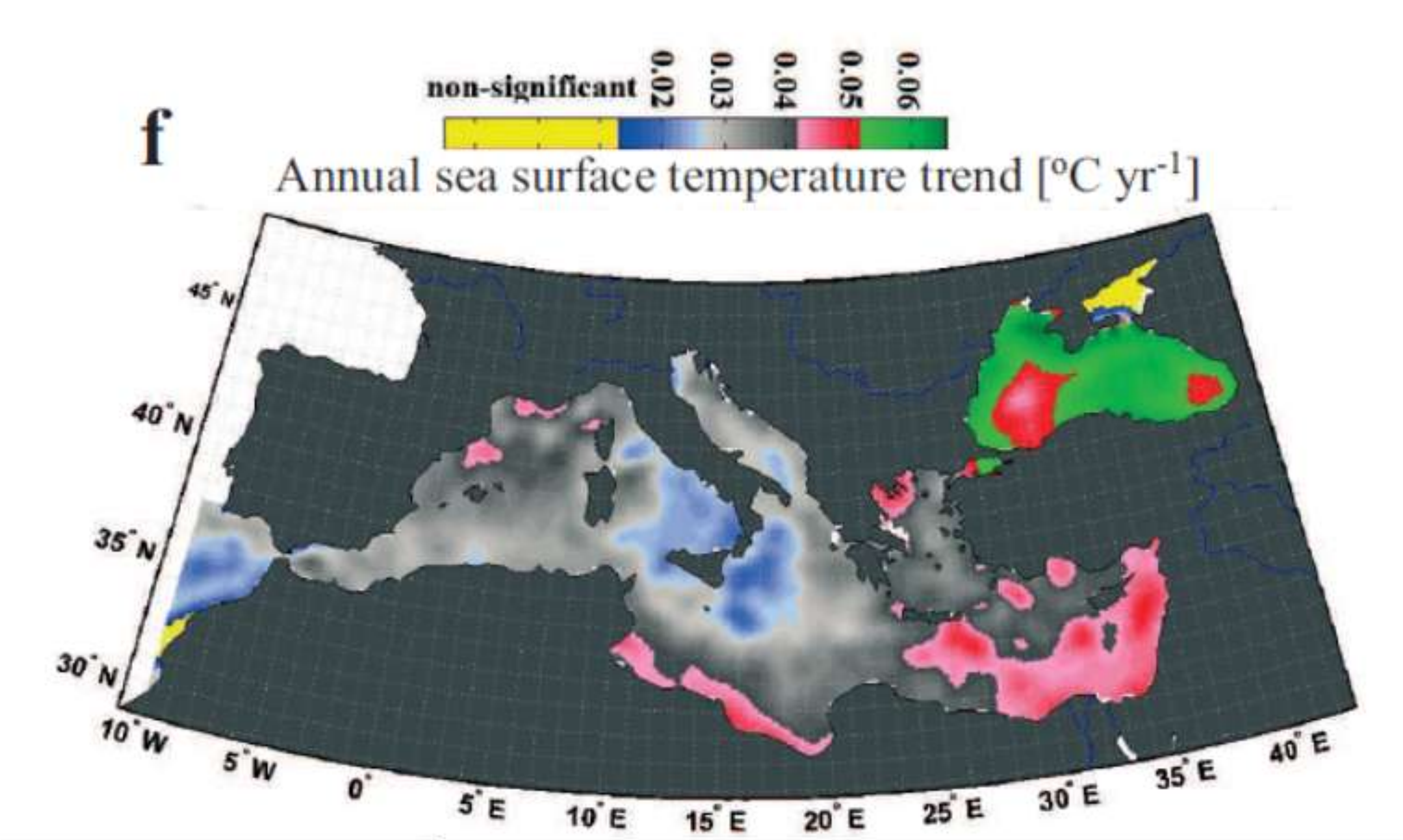




Max temperature increase: 0.42 °C/decade
In accordance with satellite data estimates by *Shaltout & Omstedt, 2014*

Warming of surface Mediterranean waters

Mediterranean sea warming is of 0.35°C per decade (1982-2012), with a trend in the seasonal variability which is maximum in spring

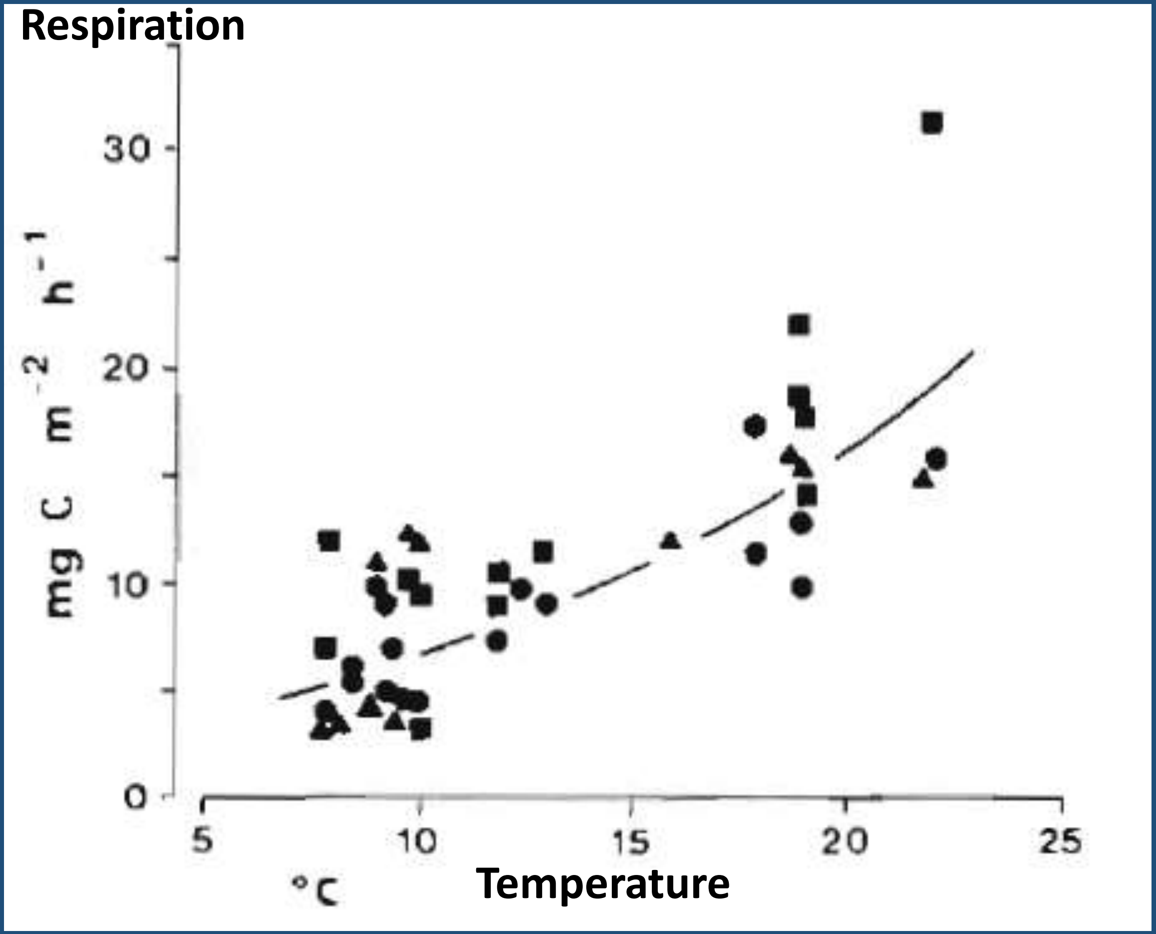


Shaltout & Omstedt, 2014

Linear correlations coefficients between water parameters and time for the time series in surface waters during summer-early autumn

Parameter	C1		00F		CZ	
	r	p	r	p	r	p
O_2	-0.399	0.000	-0.411	0.000	-0.242	0.012
AOU	0.368	0.001	0.315	0.000	0.186	0.056
Chla	-0.265	0.015	-0.185	0.039	-0.250	0.010
NO_3	0.141	0.237	-0.174	0.084	-0.095	0.363
PO_4	-0.211	0.075	-0.297	0.003	-0.365	0.000
SiO_2	0.243	0.040	0.102	0.316	0.196	0.057

Benthic respiration dependence on sediment temperature in the gulf of Trieste



from : Herndl et al, MEPS 1989

Conclusions

- O_2 increase trends in bottom waters only in the deeper part of the gulf
- O_2 (and AOU) decreases in the water column at all stations due to temperature increase and chlorophyll decrease in the water column
- Plankton respiration accounted for 57-70 % of total respiration processes (benthos+plankton)
- Respiration processes (benthic and planktonic) can consume the O_2 in 2-3 weeks to critical levels of and could reach hypoxic conditions in 5-7 weeks
- Temperature effect on respiration could have a major role on the O2 depletion in bottom waters, also in condition of P limitation trend

Acknowledgements

Cinzia Fabbro, OGS, for plankton repiration meausres
Tamara Cibic, OGS, for primary production measures
Edy Cociancich, OGS, for sampling and CTD cast
Bruno Cataletto OGS for sampling
Carlo Franzosini, AMP Miramare, for sampling

& many other technicians and researcher of NIB , ARPA FVG and OGS who contributed to sampling and analyses during the past decades


Thank for your
attention!

Questions?